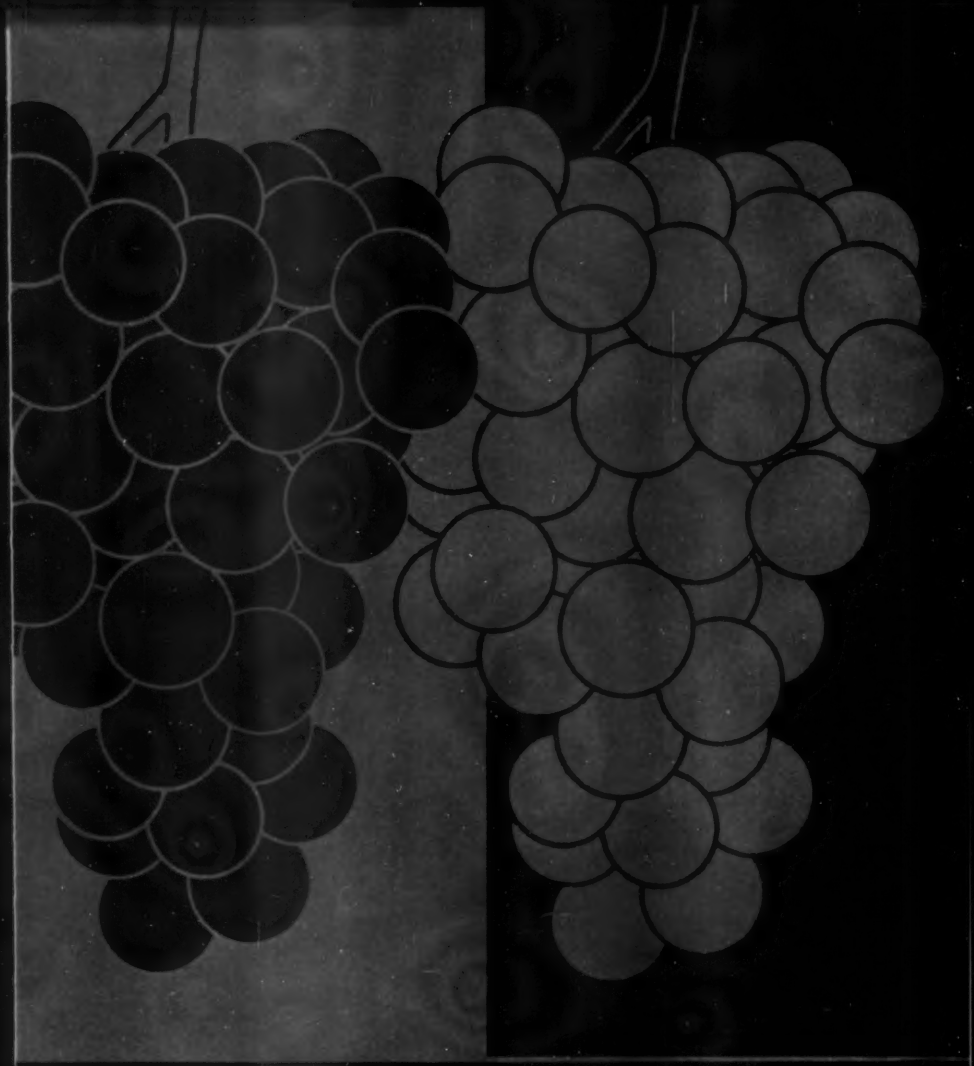

CULTURAL PRACTICES FOR NEW YORK VINEYARDS

N. J. SHAULIS AND T. D. JORDAN

CORNELL EXTENSION BULLETIN 805
NEW YORK STATE COLLEGE OF AGRICULTURE

CONTENTS

This bulletin was prepared by Nelson Shaulis, Professor of Pomology, New York State Agricultural Experiment Station, Geneva, New York, and T. D. Jordan, Associate County Agricultural Agent, Jamestown, New York. It is the second revision of a 1944 bulletin on grape production by M. B. Hoffman.

Professors John Einset and Karl Brase of the New York Agricultural Experiment Station at Geneva contributed to the sections on varieties and propagation in this publication.

CULTURAL PRACTICES FOR NEW YORK VINEYARDS

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THE GRAPE INDUSTRY IN NEW YORK

New York ranks second among the 50 states in the production of grapes. The annual average production has been 82,000 tons since 1950. California leads in total production by a 30-fold margin, but none of the commercial varieties of either New York or California is important in the other state. Major areas producing varieties grown in New York are Washington, Canada, Michigan, Pennsylvania and Ohio.

New York's grapes, of which Concord is the leading variety, are used for juice, jam, jelly, and preserves: In recent years about five percent of New York's annual tonnage has been sold for fresh fruit or has been utilized at home; another five percent has been used commercially for pulped or de-seeded grape products; 20 percent has been sold directly to wineries; and the remaining 70 percent has been pressed as unfermented juice, some of which is later sold to wineries. This represents a significant change in the use of New York grapes; prior to 1920 more than three-fourths of the crop was sold as fresh fruit.

Grape acreage in New York has shown a steady decline from about 62,000 acres in 1930 to 31,000 acres in 1955, with the acreage estimated at about 29,000 acres[1] at present. The average yields, however, have doubled to three tons per acre in recent years and total tonnage has not decreased. The only state that has recently increased its acreage of Concord or slip-skin grapes is Washington. Here there were less than a million vines in 1930 and more than four million in 1955. Average yields of Concords per acre in Washington are about double those in New York.

The greatest opportunity for expansion of New York's grape industry in the immediate future seems to lie in increasing the quantity of high quality grapes produced per acre. The technology is available to obtain a five ton per acre yield without reducing quality. The resultant tonnage increase probably would take care of normal market expansion.

Regions of Commercial Production

Commercial grape production in New York centers in four districts (figure 1). Districts are defined mainly because of markets and a combination of natural characteristics that favor crops of high-quality fruit. Climate is the chief determinate of the boundaries of these districts.

[1]Dominick, B. A. and R. Smith. *Costs and Returns, Chautauqua County Grape Farms.* New York State College of Agriculture, Department of Agricultural Economics, A. E. Res. 28, 1959.

Figure 1. Location of the commercial grape districts in New York State.

District	*Millions of bearing vines in 1954*
1. Chautauqua	9.1
2. Finger Lakes	6.2
3. Hudson Valley	1.5
4. Niagara County	0.8

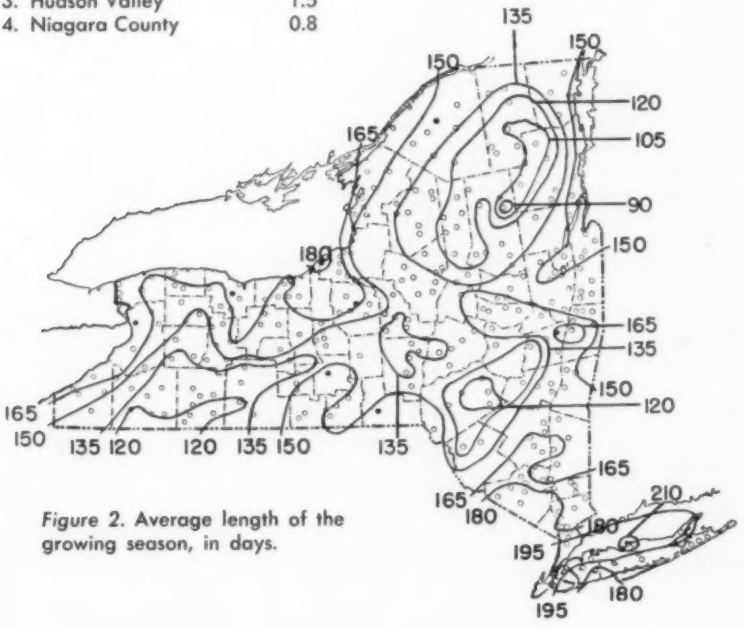

Figure 2. Average length of the growing season, in days.

LOCATION OF THE VINEYARD

Climate

New York has a diversity of climate, primarily because of wide variations in elevations and the presence of large bodies of water in parts of the state.

Cold injury determines the successful limits of all fruit plantings. Immaturity of tissue in the fall predisposes grapes to winter injury; therefore, the length and nature of the growing season as it affects maturity of the wood must be considered along with the minimum winter temperature.

A short growing season may cause immaturity of fruit, as shown by high acidity and low sugar content, as well as immaturity of trunk and buds An average growing season of at least 165 days is required for maturity of the principal varieties of grapes (figure 2). Grapes should be planted only where climatic conditions are suitable for ripening the crop satisfactorily in most seasons. Therefore, commercial plantings usually should be confined to the recognized areas.

In some localities outside of the established districts, small vineyards have produced fruit profitably for local market and home use. When such a planting is undertaken, selection of site and varieties deserves special attention.

Site

The best vineyard sites in New York State afford maximum warmth, sun, and freedom from frost (figure 3). The vineyard should be somewhat above the level of the surrounding land because cold air settles to the lower levels and the shoots or fruit may be frosted. Many good vineyards are on steep hillsides; others are successful on level land if the elevation of one or more sides is above

Figure 3. An excellent vineyard site protected by planting on a terrace grade and by a diversion ditch. This young Concord vineyard has already produced two crops at the rate of four tons of grapes per acre.

that of the neighboring fields. Vineyards should not be planted on land that is shut in on all sides by higher land. Steep hillsides probably furnish the best climatic conditions, but the cost of vineyard operations and the risk of serious soil erosion is greater than on more level land. Within a well-protected district, such as the Chautauqua Belt, elevation and exposure are of minimum importance, but become a major concern in other areas if climate or geographic features are less favorable.

Soils

Because they are more tolerant of drainage extremes than most fruits, grapes may be grown on a wide variety of soils. Vineyard longevity, ease of management, and net profit, however, will generally be greater on well-drained or moderately drained sand and gravel loams and on gently sloping somewhat poorly drained silt and clay loams. Soil texture is of concern only as an indicator of drainage, fertility, and ease of erosion.

Good yields are possible on poorly drained soils, but management is more exacting and expensive. Special efforts must be made to avoid root pruning and on sloping land to reduce excessive run-off and erosion. Artificial drainage to remove excess water and improve soil aeration is beneficial on these soils, but in some cases is impossible and at best is expensive. A vineyardist with soil of this type is handicapped in his efforts to compete profitably with others.

In well-drained soils such as Howard or Chenango gravelly loam, roots may penetrate to a depth of six feet or more, providing the vines with a large volume of soil from which to absorb nutrients and water. By contrast, in a poorly drained soil such as Canadice, root penetration is two feet or less and vines are more susceptible to seasonal extremes of moisture supply. Shallow soils such as Lordstown in the Finger Lakes area and Manlius in the Chautauqua region should be avoided.

The general characteristics of the subsoil are important and should be considered in selecting the vineyard site and in selecting management practices. Well-drained soils have bright, uniformly yellowish-brown or brown subsoil. Moderately drained soils have some mottling (spots of yellow, gray and orange) in the subsoil below 15 to 20 inches. Somewhat poorly drained soils have pale colored subsoils that are highly mottled below 6 to 15 inches. Poorly drained soils have gray subsoils, either mottled or unmottled.

You can determine the drainage class of your soil by looking for these characteristics in the subsoil or by studying a soils may of your farm. Soil association maps are available for most counties from your county agricultural agent. Detailed soils maps of individual fields are obtainable through your soil conservationist.

The soil should have a good supply of organic matter before the vineyard is set and efforts should be made to maintain it by terrace-grade or cross-slope planting and cultivation, annual use of well-fertilized cover crops and chopped grape prunings, and additions of organic materials such as straw, hay, pomace, or manure (see page 31).

PROPAGATION OF THE GRAPE

Cuttings

Most grapes are propagated easily from cuttings but certain precautions must be observed. Among the most common causes of failure are selection of immature

or frozen wood, improper care of cuttings before setting, heavy-textured nursery soil, insects, and diseases.

Figure 4. **Grape cuttings. Moderately vigorous wood growth makes the best cuttings.**

The cuttings should be made from dormant, well-matured canes of the preceding growing season. Short-jointed canes that are one-fourth to three-eighths inch in diameter are preferred.

Cuttings may be made in late fall or early winter. Cuttings are usually about nine inches long and each has three buds (figure 4). The bottom cut is made just below the basal bud and the top cut about an inch above the top bud. For convenience in handling, the cuttings should be sorted into uniform lengths, faced the same way, and tied into bundles. The bundles should be buried in a trench with the basal ends up and covered with about three inches of soil. A well-drained spot should be selected for this purpose. When cold weather approaches, the trenches should be covered with several inches of straw or manure that can be removed as soon as the weather warms.

The cuttings are planted in the nursery row as soon as the soil is in workable condition in the early spring. The nursery row should be on a deep, well-drained, fertile soil that has been put in a state of good tilth. The rows are spaced three or four feet apart, and can be furrowed by running a turn plow twice in the same direction. The cuttings are set about five inches apart along the smooth side of the furrow. The top bud should be just above the surface of the soil after the trench is filled. As the trench is filled, the soil should be tramped firmly about the cuttings. Control of weeds throughout the growing season is necessary.

Layering

Layering is the surest way to propagate all varieties of grapes, but is little used except for a few varieties that do not root readily from cuttings. It is commonly used to fill in vacancies in established vineyards because the young vine, supported by the mother vine, gets a better start than do replanted vines.

In filling vacancies by layering, a vigorous cane growing from an adjacent vine in the same row is used. A hole is dug where the new vine is desired and the end of this long cane is placed with the bend at the bottom of the hole. The end of the cane extends vertically with at least two buds above the soil surface. The long cane connecting the new vine to the mother vine should be stripped of developing shoots when these emerge; only those nodes apical to the buried ones should bear shoots.

After two or three years, the new vine is well established and should be cut from the mother vine. If its size is adequate, it can be fruited in the third year.

Grafting

Grafting is more difficult than propagation by cuttings. Nearly all vineyards are own-rooted. Nevertheless, grafting grapes may be advantageous for filling vacancies or replanting on an old vineyard site.

Grape phylloxera, or root lice, have been found in the New York vineyards where a search was made. Grape roots, like Concord and Delaware, can be injured by these phylloxera and the loss of vigor can be of commercial impor-

tance when own-rooted Concord or Delaware are set where a vineyard has been pulled within two years of replanting. Planting to fill vacancies in an established vineyard creates a similar problem.

There are many phylloxera-resistant grapes, such as Couderc 3309 and 3306. When Concord or Delaware were bench-grafted to phylloxera resistant rootstocks, vine growth and production were commercially superior to own-rooted vines in both of the situations described above. On sites that have never had a vineyard, the growth of own-rooted Concords has so far been equal to that of Concords on phylloxera-resistant rootstocks.

Grafted vines are more expensive than rooted cuttings, but, for varieties and sites where vigor is likely to be reduced by phylloxera, they are the only available control and are commercially desirable. Research is continuing for more precise means of estimating rootstock response.

It is important that grafted vines be planted with the graft union several inches above the vineyard floor so that cion rooting will not take place. Cion rooting reduces or eliminates the effect of the phylloxera resistant roots.

Top-working

Because it is difficult, top-working is seldom practiced but can be used to change an undesirable variety to another kind. The technique is cleft grafting or notch grafting of the desired variety to the two-inch high sawed-off trunk of the variety to be replaced. The general principles of such grafting are discussed in New York State Experiment Station Bulletin 773. The principles are applicable to grapes except that no wax or covering that excludes air is used.

NURSERY STOCK

High-quality, nursery-grown rooted cuttings can usually be obtained at a reasonable price. Therefore it may be more satisfactory and cheaper to buy plants from a reliable concern. The nursery man is more skilled in the art of propagation than is the average grower. He has better equipment and a soil suited for the production of high-quality vines. Almost all New York vineyards are based on such nursery stock. Whatever the source of plants, it is important to plant only strong, healthy vines.

Figure 5. One-year-old Concord nursery stock, from left to right: number 1 extra, number 1, number 2, and cull. These are common grades in use in Chautauqua County.

First-grade, one-year-old vines are best. Two-year-old vines may be used but frequently are the culls from the year before and the plants may be weak. The quality of the growth is more important than the size. Medium-sized, heavily rooted vines are usually as good as large ones. Small vines with sparse root systems should be discarded. The entire plant should have a bright, healthy appearance; the canes should be large enough in diameter to indicate high vigor and should be well matured; the roots should be strong and healthy (figure 5).

To avoid drying, vines should be planted immediately on receipt from

the nursery. If this is impossible, the vines should be upacked immediately and heeled-in on a well-drained spot. To heel-in vines, dig a trench wide and deep enough to accommodate the entire root system. Separate bunched vines and distribute them along the trench so all roots come in direct contact with the soil. Cover them with fresh, moist soil in such a way that the soil sifts in among all the roots and leaves no large air spaces. Tramp the soil firmly about the roots as the trench is filled.

PLANTING THE VINEYARD

Time of Planting

Early spring is the safest time to plant grapevines in New York State. On well-drained soil in Chautauqua County, however, fall-set Concord vines have grown as satisfactorily as those set the following spring. Fall planting is inadvisable on heavy-textured, imperfectly drained soils because heaving may damage the young vines. If vines are set in the fall, it is advisable to plow a four- to six-inch mound of soil up around the base of the young vines.

Preparation of Site and Soil

Artificial drainage and other necessary site improvement practices can be made best before setting the grapes. Land that has been in sod is excellent for fitting and planting to grapes. Vineyards planted on sites of sod apple orchards or pastures have usually been superior to those on similar land that has been intensively cultivated and cropped. Alfalfa hay fields should be soil-tested for potash before grapes are planted.

Soil that lacks organic matter should be put in grass or clover sod for several years before it is set to grapes. No way is known to grow enough cover crop to increase the soil organic matter after the vines are planted. Vineyard management is often one of the most destructive of soil management systems. Nowhere is there as much cultivation for so many years.

Land from which a vineyard has just been removed should be put on sod for two years or longer before resetting to grapes.

Direction of Rows

The slope of the land is probably the most important consideration in determining row direction. On sloping land, rows should follow the drainage grade laid out by local soil conservation technicians. Such a planting plan is the best way to prevent or reduce erosion and to preserve the site for the long life of the vineyard. Rows at right angles to the slope or cross-slope planting is a better arrangement than rows parallel to the slope, but is inferior to a terrace grade on irregular slopes.

Planting Distances

The distance between rows in the vineyard has been largely governed by the use of tractors and sprayers. A nine-foot row spacing allows ample room for any vineyard equipment now in use. It is suggested that vines be spaced eight feet apart in the row. Highest yields from experiments have been obtained at closer spacings. If low vigor is anticipated, closer in-the-row spacing will provide a higher plant number per acre and higher yields. Planting distances that afford less than the 600 vines per acre obtained with a nine by eight feet spacing usually bring reduced yields.

Marking the Field

There are many ways to mark the field. If it is to be planted along a drainage grade, the curved rows are already marked. For straight rows, a white stake can be driven at each corner of the proposed planting. At each end of the field have two white stakes about five feet tall and a pole cut to nine feet, the distance between rows. Plow a deep furrow between the stakes at each end of the first row. As each end of the furrow is completed, the pole is used to set the other white stake at the end of the next row. By keeping the end stakes in line with the corner stakes, the pole affords an easy way to space the rows. A pole the length of the vine spacing can be used in the row to space each vine as it is planted.

A headland of about 25 feet at each end of the vineyard allows room for machinery to turn. If the vineyard is long, 20-feet cross alleys at intervals of about 500 feet are helpful.

Setting the Vines

The root growth is large on vines received from the nursery. Live roots contain materials that help to give the vine a vigorous start, therefore, only broken or dead portions of the roots should be pruned. It is easy to handle this large root system when the vines are set in a deep (12 to 15 inch) furrow. The roots can be spread in the furrow, some soil firmly tramped over them, and the covering completed with a plow or disc.

The top of the vine should be pruned to the best single cane and this should be pruned to eight to ten buds. When the new shoots are no longer than one inch, all are broken off except the two topmost shoots. The base of the shoots that grow the first year thus are raised off the soil surface, and in many instances the height of the new vine is increased as much as ten inches. If those one-inch shoots cannot be broken off at the proper time, it is better to prune the best cane to two buds at planting time.

It is inadvisable to put any fertilizer materials in the furrow or hole at planting time because of the danger of injuring the roots.

THE TRELLIS

The trellis is usually constructed during the first growing season or the following spring and represents a major cost in establishing a vineyard. Further delay in the construction of a sturdy trellis will postpone the harvesting of profitable crops.

All trellises for commercial vineyards in New York are of the same general type: two or three wires, one above the other, stretched tightly on firmly set posts. Two wires are adequate and the most common system; however, some growers use three wires to obtain greater trellis rigidity. If average or greater vine vigor is anticipated the top wire of the trellis should be five and one-half to six feet above the ground to provide maximum sunlight exposure and to facilitate insect and disease control. The lowest wire should be two and one-half to three feet above the ground. Comparisons of trellises four feet high with those five and one-half feet high have shown significant yield and soluble solids increases from vines on the higher trellis. Increases were noted only if the vines were sufficiently vigorous to cover the trellis completely with foliage in August. If vigor is low, however, little is to be gained by a high trellis.

Vineyard Posts

Vineyard posts serve two functions. The intermediate or line posts provide vertical support for the trellis wires. End posts support the wire, too, but must provide an anchor point for tightening the wire and maintaining the wire tautness.

Cost per year of service is the basis on which posts should be selected; therefore they should be strong and either naturally durable or treated with chemical preservatives. Preservative treatments and comparative costs of various posts are discussed in another Cornell Extension Bulletin.[2] Steel or reinforced concrete posts are satisfactory but are not in common usage. Posts that have been pressure treated with either creosote or pentachlorophenol are excellent and their use as line posts is increasing in both the Finger Lakes and Chautauqua region.

Line posts should be eight feet long with a minimum top diameter of three inches. They should be set or driven 24 to 30 inches in the ground, depending on the trellis height desired, with the large end in the ground. Tractor powered post hole augers or post pounders are economical to use for installing posts. Line posts are usually spaced 20 to 24 feet, so that three vines grow between each two posts; therefore, the exact distance depends on vine spacing.

The end posts, because of their function as an anchor point, should be larger than the line posts and preferably longer so that they can be set at least three feet in the ground to minimize bracing problems. Used railroad ties eight and one-half to nine feet long are satisfactory for this purpose if they are sound. If they are set three to four feet deep, bracing is not usually needed. There are several ways to brace end posts, but none is completely satisfactory. The most common method utilizes an extra line post as a brace. The brace is extended obliquely from a point midway up on the end post to the ground where a two-foot stake is driven in to hold it in position. The included angle formed by the end post and the upper end of the brace should be greater than 45 degrees or the end post may be lifted out of the ground when the trellis wires are tightened. In some areas the end post is secured with a wire that extends from near the top to an anchor or "dead-man" buried in the headland 24 to 30 inches from the post.

Wire

Three sizes of wire are commonly used for vineyard trellis: numbers 9, 10, and 11. The largest, number 9, is used for the top wire; the smaller sizes are used frequently for the lower wire. The amount of wire needed for an acre can easily be calculated from the following tabulation, which gives the number of feet per ton of wire.

Size of wire	Feet per ton
Number 9	34,483
Number 10	41,408
Number 11	52,352

Galvanized wire is more durable and more expensive. Galvanized wire for the lower wire reduces serious wire chafing on one to three-year-old grape vines and is recommended.

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[2]Hamilton, L. S., and Cunningham, G. R. *Longer Life for Wood in your Fencelines and Vineyards.* New York State College of Agriculture Extension Bulletin 987, 1957.

The wires usually are fastened to the end post by winding them once around the post and firmly looping the end about the stretched wire. Recently, however, the labor savers such as cranks, the "cinch" and the "wire tite" that eliminate annual unwinding and rewinding have been developed. They are fastened to the line post by ordinary fence staples. The staples should be driven in far enough to hold the wire close to the post but with enough space left so the wires can be tightened each season.

The wires are more secure if they are placed on the windward side of the post, or on the uphill side in hillside vineyards. Each spring, after brush pulling, all loosened posts are driven down and all loose wires tightened. This is important to maintain straight vine trunks.

FRUITING HABIT OF THE GRAPE

Grape clusters are produced laterally, near the base of leafy shoots of the current season's growth. These leafy shoots arise from dormant buds on the wood (canes) of the previous season's growth (figure 6). Shoots that grow from older wood are barren. It is clear, therefore, that one must depend on wood of the previous season's growth for fruit production.

An average yield for a thrifty vine is approximately 15 pounds of fruit. The average cluster weight will be about one-fifth of a pound. To produce the 15 pounds of fruit, the vine needs to bear at least 75 clusters. Because each shoot is capable of bearing from one to three clusters, about 45 bearing shoots will produce this crop. Because only one bearing shoot can be expected from each bud, and because 15 to 30 percent of the buds do not start or the shoots are blown off, at least 55 buds are necessary to produce 45 bearing shoots. A vine has several hundred buds before pruning; therefore grapes require a severe pruning.

PARTS OF THE VINE DEFINED

The following definitions of common terms of the different parts of a vine are given so that their use in the discussion of training and pruning will be more fully understood.

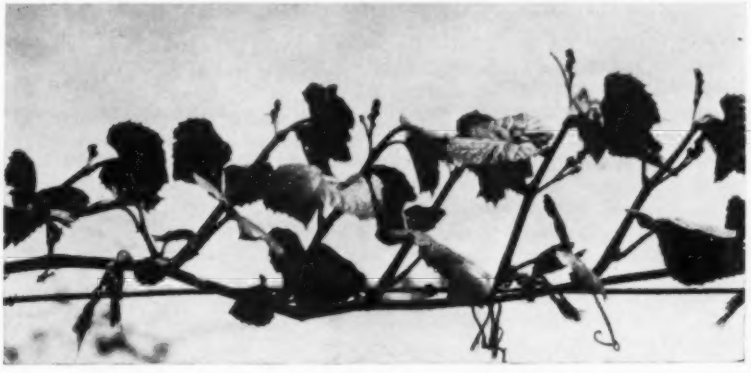


Figure 6. Blossoming shoots developing from a cane. After bearing fruit and shedding their leaves, each of these shoots is referred to as a cane.

Trunk: the main unbranched body or stem of the vine.

Arms: the main branches or extensions of the trunk.

Head: the region of the trunk from which arms or canes arise.

Shoots: new leafy growths developing from buds. They are called *shoots* during the growing season. After the leaves fall they become *canes* (figure 6).

Canes: the dormant shoots grown in the previous season.

Laterals: the side branches of a shoot or cane.

Spur or renewal spur: a cane cut back to a short stub, usually one to three buds long, to produce next year's fruiting cane at a desired location.

Nodes: the joints on shoots or canes where leaves and buds are attached.

Internodes: the wood of shoots or canes between the nodes.

Eye: the compound bud at each node on a cane.

Primary bud: the largest and strongest bud of an eye.

Secondary bud: the smaller bud of an eye.

Suckers: the shoots arising from below the ground.

Water sprouts: the shoots arising from dormant buds along the trunk.

DISTINCTION BETWEEN PRUNING AND TRAINING

The grapevine is pruned to control the quantity and quality of both wood growth and fruit. In pruning one leaves enough of the most fruitful buds on the vine for it to produce only the fruit it is able to mature. The grape is also pruned to make well-proportioned plants, with the parts arranged for the highest production of good fruit. This is training. Most growers refer to both operations as pruning, but the two terms should not be confused.

METHODS OF TRAINING GRAPES

It is necessary to train the vine in order to keep fruit off the ground and to permit easy cultivation, spraying, and harvesting. Properly trained vines are less often injured by vineyard tools, and production costs are reduced by efficient operation in a well trained vineyard.

In training grapes, bearing shoots are disposed of in two ways: they are allowed to droop or are tied upright to the trellis. If shoots are not tied, but are allowed to droop at will, the grower saves the expense of summer tying, there is less injury to the shoots by vineyard traffic or by winds, and most important, production is usually greater than with upright shoots.

In the upright method, two or more canes are laid to the right or left, either horizontally, obliquely, or vertically, on the wires of the trellis. As the shoots develop they are tied to the wires above.

The following methods of training are classified according to the disposition of the fruiting shoots.

Shoots drooping:

- Umbrella Kniffin
- Four-arm Kniffin
- Six-arm Kniffin

Shoots upright:

- Chautauqua
- Keuka high renewal
- Fan

Of these six methods, the Umbrella Kniffin, four-arm Kniffin, Chautauqua, and Keuka high renewal are the only ones used often enough in New York State to

warrant description. Research during the past 40 years has shown that Kniffin training is more profitable than the Keuka or Chautauqua systems for Concord. Fredonia, too, is best when Kniffin-trained. Limited research and observation show that Kniffin-training is well suited to the varieties Delaware, Elvira, and Niagara.

Four-Arm Kniffin

The single-stem, four-arm Kniffin training system is used most often for American grapes. When in doubt about the best way to train any New York varieties, this system is suggested. A two- or three-wire trellis is used. The lower wire is placed two and one-half to three feet from the ground, and the top wire is about three feet above the lowest wire. A single trunk reaches to just below the top wire. At each annual pruning, from two to eight canes are left. These canes arise from four arms on the trunk and extend out on the wires in both directions.

It is easy to train vines to this system. A cane is brought to the top wire as soon as the young vine produces one of enough vigor. This may be at the end of the first, second, or even the third growing season. This cane becomes the permanent trunk, consequently a straight cane is best. The cane should be tied tightly to the top wire and somewhat loosely to the bottom wire. The first canes to be trained horizontally along the wire arise from the lateral buds on the young trunk. After that, canes usually can be selected from the basal buds of the previous year's canes or from renewal spurs left for the purpose. Vines trained by the single-stem, four-arm Kniffin method are shown in figure 7.

The productivity of the canes on the lower wire is less than that of the canes on the top wire. If more than four canes are needed to obtain the proper bud number, the extra canes should be put on the top wire. On vines that are low in vigor and cannot support four canes, the bottom canes may be reduced to spurs until vine vigor is restored.

With canes placed in a horizontal position, the shoots at the end of the cane normally make the best growth. In order to encourage shoots originating near the trunk, a two-bud spur should be left near the base of each cane.

Umbrella Kniffin

The umbrella Kniffin is a modification of the single-stem, four-arm Kniffin system. Since much of the best fruit on vines trained to the single-stem, four-arm Kniffin system is borne on the two upper canes, most growers of Concord and other vigorous varieties dispense with the two lower canes but retain sufficient buds on canes originating just below the top wire to bear the entire crop. The same type of trellis is used as that in the single-stem, four-arm Kniffin system.

For the first several years, the pruning given a young vine in training it to the umbrella Kniffin is practically the same as that described for the single-stem, four-arm Kniffin system. A mature vine pruned and trained according to the umbrella Kniffin method consists of a single trunk headed four to eight inches below the top wire, with from one to six canes arising from the head of the trunk. The canes are bent sharply over the upper wire and extended down to the lower wire to which they are tied. Renewal spurs should be left at the head of the trunk. The general shape of the pruned vine is that of an umbrella (figures 8 and 9).

The canes should be bent over the upper wire so the outer bark cracks. Then the shoots that arise basal to, or back of, the bend will be vigorous and excellent for fruiting the following year (figure 11). If the canes are drooped over the top

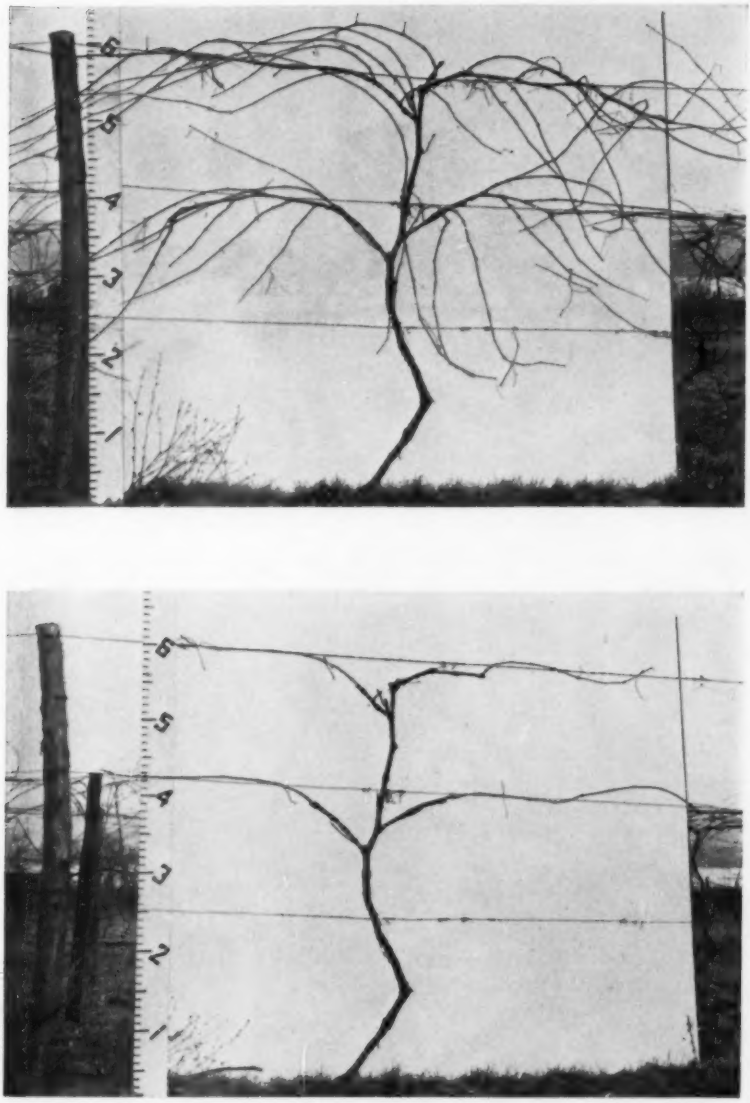


Figure 7. Top, an unpruned vine; *bottom,* a pruned vine trained to the four-arm Kniffin method. The pruned vine had 38 buds; one-year prunings of the lower vine amounted to 1.8 pounds.

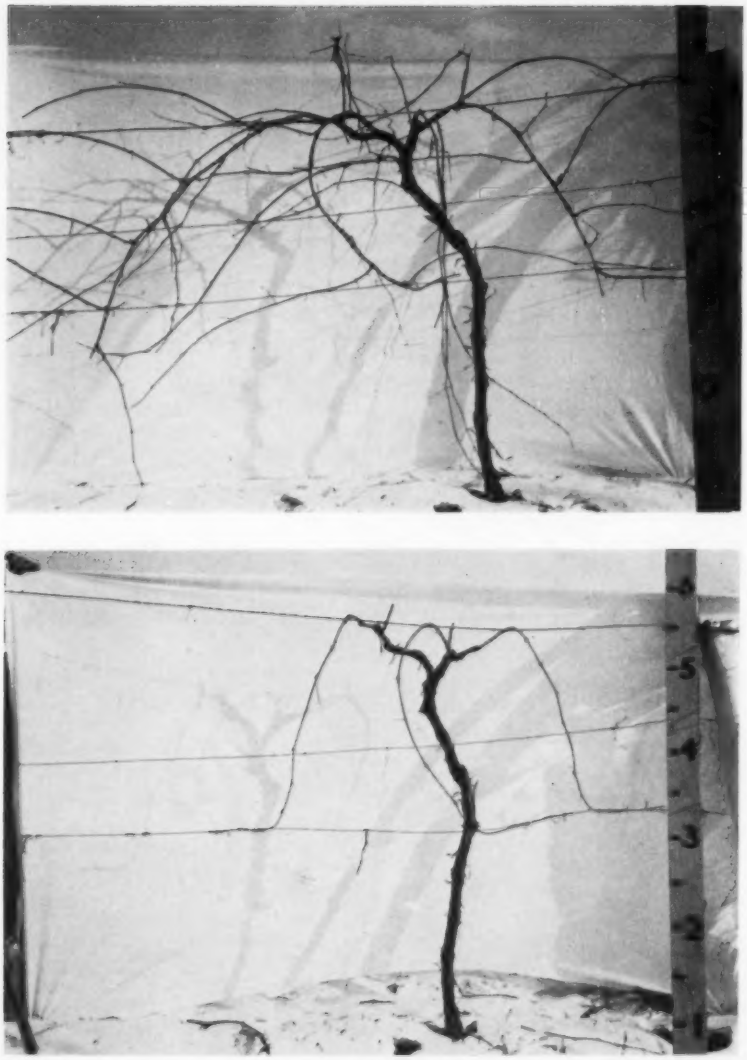


Figure 8. Top, an unpruned vine and *bottom,* a pruned vine trained to the umbrella Kniffin system. The pruned vine had 36 buds; one year prunings of the lower vine amounted to 1.6 pounds. The three-inch extension from the top of the trunk is for a very tight tie to the top wire, which helps to develop a straight trunk.

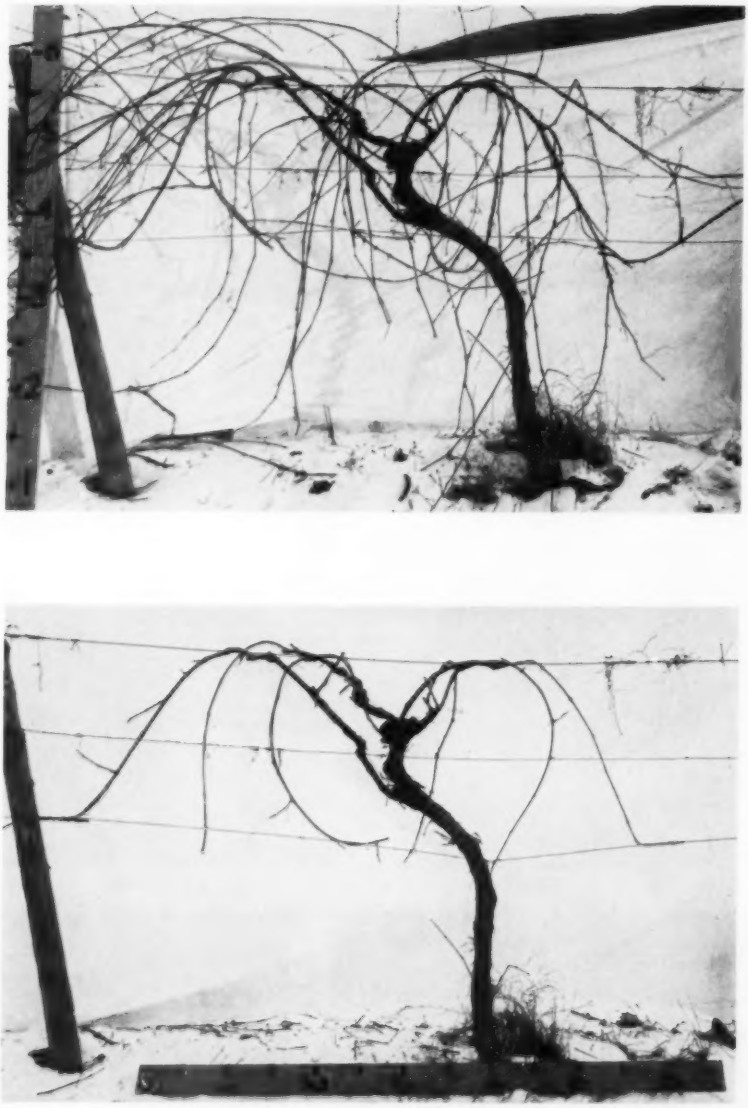
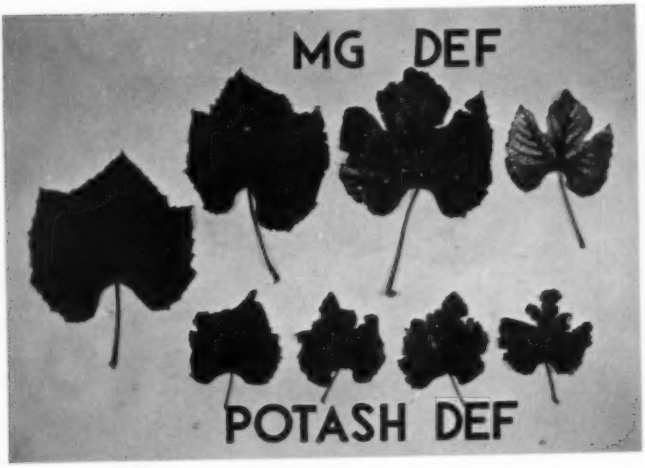
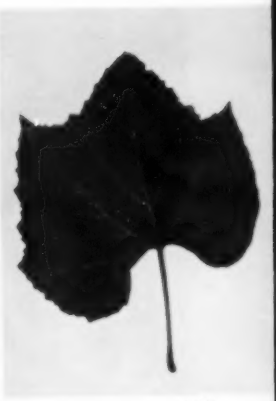


Figure 9. Top, an unpruned vine and *bottom,* a pruned vine trained to the umbrella Kniffin system. The pruned vine had 60 buds; one year prunings of the lower vine amounted to 4.0 pounds.



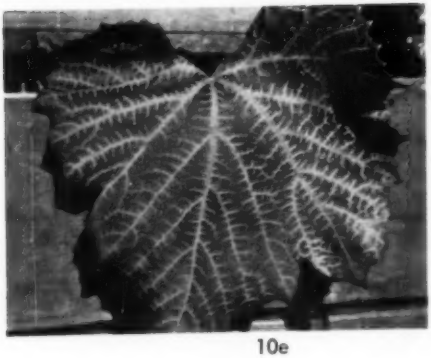
10a



10b

10c

10d



10e

10f

wire and tied so there is no sharp bend in the canes, the shoots at the tip of the cane grow most and it is difficult to obtain good fruiting canes that originate near the trunk and below the top wire.

In recent tests, yields of Concord and Fredonia vines trained to the umbrella Kniffin system have been as much or more than those from vines where the four-arm Kniffin system was employed.

Chautauqua

The Chautauqua method was used extensively in the Chautauqua grape belt prior to 1950. Three wires are put on the trellis in this system, and the top of the trunk and the bottom wire are about two feet from the ground. Permanent arms are laid along the lower wire at each side of the trunk. From two to seven canes from these arms are tied upright across the wires each year. Renewal spurs are necessary. New arms should be established as needed. The shoots that develop from the canes may be tied in an upright position as they grow.

The Chautauqua system cannot be recommended for Concord or Fredonia varieties. It is not so productive as the Kniffin training. More time and more labor are needed to tie vines trained to the Chautauqua system following the dormant pruning than for any other system, and the new shoots must be tied during summer. In addition, wind damage is greater and more retieing is necessary.

Keuka High Renewal

Several systems of training have the general name of *high renewal*. The Keuka high renewal is probably the most common of these. A three-wire trellis is commonly used for this system, and the procedure in training a young vine is similar to that for the Chautauqua system. New canes, one on the right and one on the left of the trunk, are laid down along the lower wire each year. If the vines are vigorous, additional canes may be tied up to the second wire. Renewal spurs for the development of the following year's canes should be left near the head of the trunk. The new shoots that grow from the canes must be tied up to the wires as they develop. In general, the Keuka high renewal system increases vine vigor but the shoots so trained are less fruitful than those on umbrella trained vines.

Figure 10. Tell-tale signs of Concord vineyard management. *10-a (top)* Normal through three stages of magnesium (Mg) deficiency. This does not stunt leaves and is most severe on the basal leaves. *10-a (bottom)* Normal through four stages of potassium deficiency. This stunts leaves and is most severe in the mid-portion of the primary shoots. *10-b* Black-leaf of Concords is minimized where there is adequate potash. Liming increases black-leaf where potash is low. Symptoms are found only on exposed leaves. *10-c* A normal leaf. *10-d* Acute potassium deficiency shown by leaf scorch and small size of berries. *10-e* Chlorosis from excess diuron (Karmex). This leaf is similar to those from vines receiving triple the recommended maximum rate. *10-f* A leaf showing manganese deficiency. This and potash leaf scorch (10-a and 10-d) are very serious deficiencies.

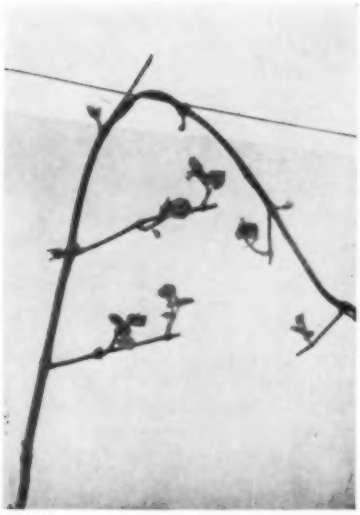


Figure 11. Proper use of a vigorous Concord cane on which the laterals are pruned to one or two buds. This amount of bending of the cane over the top wire is considered good.

Figure 12. Weighing the cane prunings from the vigorous Concord vine shown in figure 9.

THE GROWTH YIELD RELATIONSHIP

Vine Growth

Leaves produce almost all of the dry weight of grapes or of a grape vine, and produce all of the sugar. Vineyard trellising, fertilization, weed control, and some spraying are done to develop a large area of well exposed leaf surface that is sound and is reasonably near the fruit. In the low vigor vineyard, the leaf area is not large enough but is very well exposed; in the vineyard of good vigor, there is a large leaf area that is well exposed; in the vineyard of excessive vigor, there is a very large leaf area but the leaves near the fruit are not well exposed to light and by harvest may have yellowed and fallen from the vine.

Measures of Vigor

A useful measure of vigor is the weight of cane prunings. (See figure 12 and table 2.) If the trellis is five and one-half to six feet high and vine spacing is eight feet, a desirable weight of cane prunings is two to three pounds per vine. At low-vigor, the pruning weight is under one and one-half pounds; for high vigor it is three to four pounds; at excessive vigor it is above four pounds. For a vine spacing of 16 feet, a pruning weight of five pounds is not excessive if the shoots are evenly distributed over this space.

Another measure of vigor is an estimation, at harvest time, of the percentage of the trellis covered by grape leaves. A desirable vigor, with this estimate, is 80 to 90 percent coverage.

Crop Effect on Vine Vigor

For low vigor vines whose growth is maintained with a crop of two tons per acre, a crop *increase* to four or five tons will seriously reduce vine vigor; a crop *decrease* to one ton per acre can increase vigor by about one-fourth. The crop effect on vine vigor is greatest with low vigor vines.

Experimentally, vines of high or excessive vigor whose growth was maintained with a crop of five tons per acre have not declined in vigor by increased cropping within the range of crop yield that can be matured normally. However, their vigor was very seriously *increased* by halving the crop. The best way to reduce the excessive vigor of vines is to withhold nitrogen and to control weeds between rows only by mowing.

Vine Vigor Effects on the Crop[3]

Experimentally, vine vigor increases up to two to three pounds of cane prunings per vine substantially increase the vine's capacity to bear ripe fruit and, with balanced pruning, the crop is increased. The maturity of the crop is not appreciably delayed until the crop is in excess of four tons per acre.

With a crop of five tons per acre and vines in the vigor range of three to eight pounds of cane prunings, crop maturity has been delayed by vigor increases; the capacity of the vine to produce *ripe* fruit is decreased. This maturity delay probably results from shading of the foliage of the basal half of the bearing shoots which, in many instances, are more than ten feet long.

Successful grape culture depends on these three general factors:

1. Growing, each year, a vine of the correct vigor.
2. Controlling the crop size (by dormant pruning and, in some years, flower cluster thinning).
3. Preventing damage to the crop or vine. This is mainly a matter of disease and insect control for which the grower is referred to the county agricultural agent or to the Department of Plant Pathology or the Department of Entomology of the New York State College of Agriculture.

Management to Affect Vine Size

Identification of non-nutritional factors in low-vigor vineyards. Vines that are spaced at eight feet in the row and that grow only one-half to one pound of cane prunings do not have enough leaves to mature a four-to-six-ton crop of grapes. At harvest time in these vineyards one can see through several rows of grapes; leaves should be in these spaces. Here there is a need to increase vigor.

For these vineyards, the low vigor may be caused by one or more of these factors other than lack of nutrients (fertilizer):

	Possible remedial action
Shallow soil that is droughty	None. Shallow tillage is suggested
Soil that is not drained well enough	None. Shallow tillage is suggested
Over-cropping by retaining too many buds	Balanced pruning
Root injuries by deep (three to five inch) tillage	Shallow tillage
Injuries by root pests	None
Winter injury to trunk	Trunk renewal
Dead arm lesions on trunk	Trunk renewal

[3]Research on which this section is based was partially supported by five annual grants from the New York State Concord Grape Research Production Fund.

It is very important that the grower know the basis for the low vigor, if treatment is to be effective.

Vineyard fertilization. Fertilizers are useful only when an adequate supply of a nutrient is not obtained from the soil by the vine. Deficiencies may not be present if the soil is fertile; when they do occur, it is usually one at a time.

Between 1944 and 1959, five trials of vineyard fertilization were conducted with Concord and Catawba varieties in the Chautauqua and the Finger Lakes districts. These trials showed that vine vigor was increased by fertilization only if visual symptoms of nutrient deficiency appeared during the previous growing season. The conclusion is that *vines without symptoms at the previous harvest will not grow or produce more as a result of mineral fertilization.* For symptom-showing vines, the correct fertilizer can increase vigor, berry size, and soluble solids.

Diagnosis of fertilizer need is the key to proper fertilization; it can be stressed by noting the wide range in fertilizer needs of five different vineyards of mature Concords on the same soil type: One vineyard may need no fertilizer because the foliage is symptomless and the cane pruning weight is above three pounds; another may need only magnesium because the vigor is high and there are symptoms of magnesium deficiency (figure 10a); a third may need only nitrogen because it has low vigor, no other symptoms; a fourth needs much potassium because these deficiency symptoms are serious (figures 10a and 10d); and the fifth does not respond to any fertilizer because of root injuries.

Diagnosis by leaf symptoms and/or petiole analysis. Faulty nutrition can cause grape leaves to be stunted, yellowed, blackened or killed. These symptoms can be used to identify the deficient element. The extent of the deficiency can be accurately gauged by the time at which the symptom appears or by severity of the symptom.

If the grower is familiar with the leaf symptoms of potassium, magnesium, and manganese deficiency, he should walk his vineyards in late August or early September to determine whether symptoms are present (figure 10c).

Potassium deficiency, as scorch, is illustrated in figures 10a and 10d. When most acute, these symptoms can be seen just after grape bloom. Another symptom that can be reduced in severity by potash applications is black leaf (figure 10b).

Magnesium deficiency (figure 10a) is most severe on basal leaves as contrasted to the mid-shoot position of the leaves most affected by potassium deficiency.

Manganese deficiency (figure 10f) is found mainly on high-lime soils.

Iron deficiency, found only on high lime soils, causes a whitening of the apical leaves in May and June.

Figure 10e shows Concord chlorosis caused by excessive amounts of Karmex weed killer. It is shown here because it might be confused with magnesium deficiency. Other causes of characteristic leaf chloroses are drought, sun scald, leaf hoppers, and dead arm.

County agents and processors' fieldmen can be a great help in symptom identification. Familiarity with leaf symptoms has made it possible to identify and gauge the severity of these nutrient deficiencies in most of the problem vines studied in the four-week period preceding grape harvest.

The vineyardist or fieldman who is alert can notice the beginning of deficiency symptoms on only a few vines per acre. This can occur before a petiole sample,

which may mix symptomless and symptom-showing vines, would be of most use and long before a randomly collected soil sample is useful.

Analyses of a late August or early September sampling of petioles from the youngest mature leaves from the bearing primary shoots of symptom-showing vines can identify and gauge the severity of a mineral nutrient deficiency.

Another feature of petiole analyses includes pointing up elements that may become deficient or which are in such high amounts that additions are not necessary.

Diagnosis by soil analysis. A soil test alone is useful on a site to be planted with grape vines *only* if soil test data have been co- -elated with vineyard fertility trials. This has been attempted and the correlation is far different and much less exact than with annual crops. For example, for field crops on Chenango soils, a response to added potassium may be expected if the available potassium is less than 80 pounds per acre. On Chenango soils, grapes have responded to additional potassium when the soil had 200 to 250 pounds of available potassium.

A soil test is not nearly so accurate in identifying a deficiency as are leaf symptoms or petiole analyses. However, after a deficiency has been identified by symptom rating and/or petiole analyses, a soil test may be useful in determining the nature of the treatment to eliminate the deficiency.

Diagnosis by vine growth. The amount of vine growth or vigor of vines that are free of leaf symptoms at harvest time is an excellent means of determining the need for nitrogen fertilization. If your vineyard has more vigor than you wish it to have, apply no nitrogen; if it is excessively vigorous, no nitrogen and mowing, instead of discing, are suggested. If it needs much more vigor, apply up to 80 pounds of nitrogen per acre per year and maintain good control of weeds.

Timing the fertilizer application. The greatest benefit from a nitrogen fertilizer is derived if the nitrogen gets into the tissues of the vine about the time growth starts, when it may influence the size of leaves, shoot growth, and fruit set. The application should be made in early spring about one month before the beginning of growth. For this reason, a good nitrogen fertilizer for the vineyard should be quickly available so the vines can obtain the amount needed early in the growing season rather than in the latter part of the summer.

No data are available on the best time for application of potash, magnesium, or manganese; if a vineyard is deficient, however, the sooner the deficiency is corrected the better. If the application is made before harvest, the rate can be varied with the severity of the symptoms. When symptoms are first observed, an application should be made not later than bloom if much effect is expected in the year of application.

Nitrogen: The choice of material should be on the basis of cost per pounds of nitrogen. Thus, if ammonium nitrate (33 percent) is priced at less than double the cost per ton of nitrate of soda (16 percent), it is the better buy. An exception is with high lime soils which show manganese and/or iron chlorosis; here amomnium sulfate would be the better nitrogen fertilizer.

Rates from 0 to 80 pounds of actual nitrogen per acre depending on vine vigor. Broadcasting nitrogen is satisfactory because there is little or no fixation of nitrogen in a cultivated vineyard. An annual broadcast application of

Table 1. Amount of fertilizer materials to supply various amounts of nitrogen

Actual nitrogen	Nitrate of soda (16 percent)	Ammonium nitrate (33 percent)	Urea (45 percent)	Ammonium sulfate (21 percent)	A mixed fertilizer with 10 percent nitrogen
Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
30	188	91	66	143	300
40	250	121	88	190	400
50	313	151	111	238	500
60	376	182	132	286	600
70	439	212	154	333	700
80	500	242	178	381	800

40 to 60 pounds of nitrogen per acre of vineyard usually is adequate for maintaining vigor; less should be applied if vines are excessively vigorous; more where vigor is low.

Potassium: There are two major potassium carriers: potassium sulfate (also called sulfate of potash) which contains 50 percent potash, and potassium chloride (also called muriate of potash) which contains 60 percent potash. The chloride of potassium chloride can cause injury to some plants when used at high rates. In some vineyard experiments here and in Europe, the grape has been less responsive to potassium chloride than to potassium sulfate; therefore, potassium sulfate is recommended even though it is slightly more expensive.

Stable manure or grape pomace plus stems, are low analysis potash fertilizers that are valuable in the vineyard. They can be effectively used at rates of five to fifteen tons per acre. Waste hay or straw at rates of two to three tons per acre are similarly useful.

The diagnosis from leaf symptoms, petiole and soil analyses, soil texture, and magnesium deficiency symptoms all affect the decision on rate of potash application. The range in rates of actual potash needed in deficient New York vineyards is 100 to 400 pounds per acre.

Potassium fertilizers tend to be fixed in the surface of the soil, even Howard gravelly loam. If less than two percent of the leaf area is chlorosed by potassium deficiency in early September on a clay soil of pH 7, more than twice as much potassuim fertilizer is needed as for a sandy soil whose pH is 5.0. The response of potassium deficient vines to given amounts of potash fertilizer is much increased if the application is made in a band about two feet wide beneath the trellis, instead of broadcasting it.

If leaf deficiency symptoms appear in June, July or August, an immediate application of sulfate of potash is suggested at the rate of 400 pounds per acre for sandy or gravelly loam soils; for loam to clay loam soils the rate should be 600 to 800 pounds per acre. On the lighter soils, a soil test should be made to determine the magnesium level. With a serious potassium deficiency, vine vigor, crop and berry size are reduced and maturity is delayed.

Vineyards free of potassium deficiency symptoms throughout the growing season are very unlikely to respond to any applications of potash in the following year.

Magnesium deficiency is most frequently found where the soil is very acid or where excessive amounts of potash fertilizer have been applied. Dolomitic limestone is high in magnesium and can be broadcast in the vineyard at rates from one-half to one ton per acre to supply magnesium if the soil pH is below 5.6. In acute cases of deficiency, the use of 16 pounds of epsom salts (magnesium sulfate) per 100 gallons of spray, applied at 200 gallons per acre, in two post-bloom sprays will reduce the severity.

Manganese deficiency occurs most often on soils whose pH is near 7. The cure for this, aside from the nitrogen carrier suggestions on page 24, is to apply fertilizer grade manganese sulfate in bands to the soil at the rate of one-half to one pound of the carrier per vine.

Fertilizer grade manganese sulfate need not be applied annually; symptom appearance should be the guide.

Phosphorous, calcium and iron. There has been no evidence of response of Concord or any eastern-grown grape to applications of phosphorous or calcium to the vineyard. The phosphorous applied to vineyards in complete fertilizer does not affect the grape vine behavior in any measurable way, and is not recommended except as needed for cover crops.

Calcium additions, as lime, will do no harm in high-potash vineyards, but they will harm low-potash vineyards.

Iron deficiency appears as a whitening of the leaves near the tip of the shoot; it is most evident in early June, in high-lime vineyards, and in conditions of poor drainage. No corrective is suggested except the use of ammonium sulfate as a nitrogen source.

Liming the vineyard. Vineyard fertilization usually is less expensive and less difficult with soils of pH 4.5 to 5.5 than it is with soils of pH 6.5 to 7. Potash deficiency was increased by the application of one ton of dolomitic limestone to a loam soil of pH 5.4. Manganese deficiency can also be increased by excessive liming.

Liming is useful if there is a magnesium deficiency and it might be useful if the potassium status is high and the soil pH is below 5.5. Only dolomitic lime should be used at a rate of not more than one ton per acre.

Irrigation. Unpublished reports of vineyard irrigation experiments conducted in four mature Concord vineyards in Chautauqua County in 1947–1949 conclude that supplemental irrigation is not likely to be useful on Chenango or Howard gravelly loam soil. The Soil and Water Conservation research group participated in this effort.

Controlling the Size of Crop

The two major reasons for reducing the grape vine's production below that of an unpruned vine are to increase the quality of the current season's crop and to force the production of shoots, leaves, and buds by which the vines bearing capacity is maintained for the following year. Pruning, which must be done each year, is usually the only practice used to achieve both goals. Flower cluster thinning is used under special conditions.

Time of pruning. Winter injury from temperature below —15°F. is more likely to occur on early (November, December) pruned vines than on March-pruned

vines of Concord. Except for this fact, pruning may be done in the interval between leaf-fall and bud-break. It is a good practice to finish pruning by late March.

Selection of fruiting canes. There is a wide variation in the fruitfulness of the buds on a cane, and even wider variation when all the buds on a vine are considered. The following conditions are associated with high fruitfulness of a grape bud on a primary cane:

1. Full exposure to the sunlight of the leaf which grew from the node at which the bud is located causes the cane to be dark brown in color; shading causes the cane to be yellow or yellow-brown and to have long internodes, seven to ten inches.

2. Location at a node from which a large leaf grew for most of the season; such large leaves grow where the cane diameter is one-fourth inch or more.

3. Location at a node from which the lateral growth is weak. Where the lateral growth is vigorous (over two feet long), the lateral should be spurred to two buds (figure 11) because the basal buds on vigorous laterals are probably the most fruitful on the vine.

Point of origin of the cane is much less important than the three conditions mentioned above. Canes that were suckers or waterspouts one season can be expected to fruit the next season to the extent that they meet the three conditions above.

The length of the cane retained for fruiting should be less for small-diameter than for large-diameter canes. For Concords, the use of eight to sixteen buds per cane is accepted vineyard practice. Vine spacing, and trellis wire spacing affect the practical choice in this matter.

For Catawba, research has shown that canes with eight to ten buds are much more fruitful than those with three, four, or six buds.

Number of Buds to Retain on Each Vine. Directions for pruning a grapevine often suggest leaving four canes, each of ten buds. For a Concord vine producing two pounds of one-year prunings, this is correct. For a vine of greater or less vigor, such pruning is incorrect. A reliable guide to pruning severity is the weight of cane prunings.

During the past 12 years, the following scale has been a successful guide to determine the number of buds to leave for fruiting when pruning vines at least four years of age:

Table 2. Number of buds to retain on each vine

Weight of cane prunings	Number of buds to retain for fruiting		
	Concord and Delaware	Fredonia	Catawba
Less than 1.0 pounds	Less than 30	Less than 40	Less than 25
1 pound	30	40	25
2 pounds	40	50	35
3 pounds	50	60	45
4 pounds or more	60	60	45

For example: Estimate the weight of canes on the unpruned vine. If the estimate is 3 pounds and the variety is Concord, prune it to about 60 buds. Cut the prunings to about 4-foot lengths and weigh them. If they weight 2 pounds, the bud number is reduced to 40; if they weigh 3½ pounds, the bud number is reduced to 55. After a half-day of estimating, pruning, weighing, and counting, the pruner has a more critical eye and can proceed without weighing each vine.

The extra work of weighing the prunings and leaving a bud number dependent on that weight has been practiced by research men for the past 35 years. This was first done by Dr. Partridge of Michigan who suggested a 30+8 scale using one and two-year prunings of Concord. New York work modified this to a 30+10 scale using only one-year prunings after trials with more-severe as well as less-severe pruning for Fredonia, Concord, Catawba and Delaware.

Severe pruning (low bud number) might be defined as that which always results in less crop than the vine can mature, and thus in an increase in vine vigor. Proper pruning results in as big a crop as the vine can normally mature and in a maintenance of vine vigor. Light pruning (high bud number) results in a bigger crop than the vine can normally mature and thus in a reduction of vine vigor. The 30+10 scale for Concords is the nearest that research has brought us to proper pruning and it is strongly recommended. It is based on an estimate of vine vigor, the choice of the most fruitful canes, counting the number of buds retained, and on their normal productiveness.

Flower cluster thinning is the removal by hand of some of the flower clusters before bloom; this is most cheaply done as early as they appear. One or two flower clusters usually are removed from each shoot. Flower cluster thinning has been used only in years of excessively high bud-fruitfulness especially when grape bloom is delayed by a week or more. It is a vigor-increasing practice.

In 1950 and 1956, the vines in Chautauqua County were exceptionally fruitful. In 1956, 30+10 pruned vines in one experimental vineyard yielded 8.5 tons per acre; these reached 13 percent soluble solids 107 days after bloom. Similarly pruned vines from which two-thirds of the flower clusters were removed, produced 4.1 tons per acre and reached 13 percent soluble solids in 91 days, more than two weeks earlier. New York growers can not afford to prune so severely each year that crops in the occasional years like 1950 and 1956 will not be excessive. 30+10 pruning, coupled with flower cluster thinning in these exceptional years, appears to be a very useful combination.

HANDLING THE VINE PRUNINGS

Anytime between pruning and the start of shoot growth, all the prunings should be pulled from the trellis and placed between the rows where they can be reached with brush chopping equipment (figure 13). In removing the prunings care should be taken to avoid breaking the retained canes. Tying is easier if the prunings are chopped before the tying operation is started.

FRUIT AND VINE MATURATION

The early maturity of grapes (and the vine) is more certain if: an early maturing variety is grown; grapes bloom earlier than June 15; the average temperature during the growing season is above 70°F; the crop is normal or less

Photographs by Charles Flagg

Figure 13. Vine prunings from two rows have been pulled together at left. At right they are being chopped with one of several effective types of choppers.

than normal in size; there is enough trellis space for season-long exposure of the leaves at the base of the fruiting shoots; the leaves are free of injuries by diseases, insects, and nutrient deficiencies; and the first fall frost does not come before late October.

The ripeness of the fruit and of the canes are closely related. On a vigorous vine the ripest fruit will be found on the well-exposed shoots that will mature into canes; the least mature fruit will be found on the shaded shoots that will be frost-killed for half or more of their length.

Concord berries usually show the first pink coloration in mid-August; at this time the soluble solids content is about eight percent. Table 3 is an example of the increase of soluble solids of one of the flavoring compounds, and of color, and the decrease in acids, during a ripening season. The soluble solids content of grape juice is mainly of sugars and thus is very closely related to the sugar content. It is an excellent measure of grape maturity because it is also a reliable estimate of juice color.

The date for harvesting grapes for processing is generally determined by the time at which the grapes mature to the extent desired by the processor. For fresh fruit purposes, the harvesting should be only of ripe, sound, grapes. If earlier harvesting is desired, plant an earlier-maturing variety.

Table 3. Approximate composition of the juice of Concord grapes harvested from one Chautauqua County vineyard on various dates in 1948*

Date of harvest	Sugar	Acid	Color	Flavor constituent†
	Per cent	*Per cent*	*Relative scale*	*Milligrams per liter*
Sept. 9	12	1.8	15	0.6
Sept. 16	13	1.5	30	0.8
Sept. 23	14	1.3	45	1.5
Sept. 30	15	1.2	80	1.9
Oct. 7‡	15	1.2	...	4.6
Oct. 15	17	1.1	90	...
Oct. 20	17	1.1	100	5.3
Oct. 27	17	1.2	110	4.6

*From *Ripening Studies of Grapes Grown in 1948 for Juice Manufacture*, by Willard B. Robinson, and others. Fruit Prod. Jour. and Amer. Food Mfgr. 29:36–37. 1949.
†This was methyl anthranilate.
‡Start of commercial harvest.

WEED CONTROL

Efforts to grow grapes in sod have shown that sod culture reduces vine vigor and yield, but they do not prove that the most grapes come from the vineyard that gets the most cultivation. The intensity and duration of weed control will need to be varied seasonally depending on weather, site and vigor. The least vigorous vineyards will require the most complete and longest period of weed control in any season. The vineyardist can reduce his income and harm his soil by excessive cultivation that results in lower organic matter and erosion. The only justification for cultivation is weed control, and it should never exceed two to three inches in depth or serious damage to roots will result.

Between the Rows

Weed or cover crop growth between the rows is usually reduced by tillage in the spring and can be accomplished then by a chemical spray or by discing and should be completed early enough to avoid harmful competition with the vines for moisture. The exact timing should depend on soil moisture and vineyard vigor. Dry sites, or vineyards which are low in vigor from causes other than poor drainage, will require earlier control of weeds between the rows with the same weather conditions than will those sites where moisture is adequate or vigor is high or excessive. The correct time for starting tillage between the rows is normally sometime during May. Weed control should be maintained as long as moisture competition is a problem, usually until mid-August but occasionally until early September.

Under the Trellis

Weeds under the trellis can be controlled by mechanical removal with a tractor powered hoe or by chemical sprays. Before 1957 more than 95 percent of New York's acreage was mechanically hoed. In 1960, however, more than one-third of the acreage was weed sprayed.

In preparing a vineyard for mechanical hoeing, a four to seven inch ridge of soil must be pushed up around the base of the vines each August, or at the last cultivation, with a tractor mounted hoe. This procedure, of course, covers and controls many weeds. In early June this ridge and the growing weeds can be hoed away with the tractor hoe (figure 14). If weeds are removed too early by hoeing, weed control under the trellis will be poor in late summer and harvesting more difficult. Hoeing, at best, cuts some roots and occasionally entire vines are removed. Vine damage can be reduced by careful operation, a large ridge to permit shallow operation, straight trunks to reduce the hazard of mechanical injury, cover-crop seeding and fertilizing only between the rows.

Chemical Weeding

Chemical weeding can be accomplished by annual applications of Karmex. The increasing popularity of chemical weeding stems from its economy, effectiveness, and safety when properly done. Details of this practice are given in Cornell Extension Bulletin 1026. See this and current recommendations. All chemical weed control references are based on 1960 labeled and recommended materials. Consult your county agricultural agent for current recommendations.

Grapes are especially sensitive to 2,4–D and 2,4,5–T. These chemicals should *not* be used in or near the vineyard or in equipment that is to be used in the vineyard.

SOIL COVERS

Vine Response

On the basis of measured vine response, there is no evidence that cover crops increase vine growth or yield over that in which no cover crop, or less cover crop, is used. Cover crops that grow when the vine is growing do compete with it for water and nutrients. If there is an abundance of nutrients, or if vine vigor is high or excessive, this competition does no harm and may be useful in reducing vine growth. If vine vigor is low, competition is undesirable because it reduces vine growth.

The nature of the cover crop seems of little importance, the time of growth and the amount of growth are important. The extent of competition will be greater on shallow soils, in dry seasons or on low-fertility soils than on deep soils, high fertility soils, or in seasons of high rainfall.

Soil Response

On the basis of measured soil response there is overwhelming evidence that a soil cover, be it dead or alive, is superior to a bare soil in erosion control and retention of runoff. Vineyard sites have been ruined by a combination of bare soil and rows that are parallel to the slope. Early spring growth of vineyard cover crops tends to remove excess water and makes vineyard travel easier and less damaging to vine and soil.

Figure 14. **Tractor hoeing between vines; note that the ridge in foreground will be removed.** ***Photograph by Seaton Mendall***

Figure 15. **Waste hay or straw between rows. An application of from two to three tons of hay or straw to the acre after the last cultivation is an excellent soil building practice.**

Each vineyardist must weigh the matters of vine vigor, soil fertility, drainage and rainfall and then tailor his use of cover crops accordingly.

Frost-hardy covers such as rye, wheat, ryegrass, or barley usually will afford more soil protection than frost-killed cover crops like oats or millet. Legumes are not useful for vineyards in New York.

As a base of reference, we suggest the seeding by drill or broadcast of a frost-hardy cover crop when tillage is completed in mid-August to mid-September. Suggested seeding rates per acre of vineyard are 6 to 10 pounds of domestic ryegrass or 1½ bushels of rye, wheat, or barley.

This can be trashily disced or sprayed about the time the shoot growth starts and can be 80 percent to 90 percent destroyed by early June.

For vineyards in which erosion is a problem and soil organic matter is low, it is suggested that organic materials such as manure, water hay, and pomace plus stems, be hauled into the vineyard to add to the chopped prunings and cover crop. Hay or straw can be scattered in bales in the vineyard and spread with a brush chopper (figure 15).

For level vineyards of high to excessive vigor and high fertility, a continuous cover mowed close to the soil would be appropriate.

Wise management of cover crops requires continual diagnosis of the problem.

VARIETIES

The success of the vineyard depends to a large extent upon the varieties it contains. In choosing a variety, one should consider its adaptability for the locality and the various uses that can be made of the fruit. A variety that is in demand for several purposes has a larger market outlet than has one used for a single purpose. In planning a commercial vineyard, the variety should be chosen in consultation with the processor who will purchase the fruit or on the basis of available facts about market demand.

As with other fruits, hundreds of varieties of grapes have been named and introduced, but only a few have assumed commercial importance in New York. New varieties are being originated and it may be desirable to test a few vines of the more promising ones under your local conditions.

Only in local areas with long growing seasons would it seem advisable to plant varieties which ripen later than Concord. A more practical way to lengthen the commercial grape season in New York State would seem to be through the use of varieties that ripen earlier than Concord.

Leading Commercial Varieties

Concord is the leading commercial variety in New York State. It comprises approximately 85 percent of the plantings. The remaining acreage is made up largely of Catawba, Delaware and Niagara. The relative importance of these varieties in the principal grape districts of the State is shown in table 4.

The many ways in which the fruit is used gives Concord a larger market outlet than any other variety of American grapes. Concord also succeeds on a greater number of soils and under a wider range of climatic conditions than other varieties.

Concord bunches and berries are of fair size, and the abundance of bloom that covers the blue berries makes a handsome fruit. Concord is the variety most in demand for grapejuice; it is used for wine production more than any other variety grown in New York; it is a popular table grape, and is widely used for grape jelly and grape preserves produced in New York.

The Concord has some faults. Its foxy taste is preferred by many; others consider it objectionable. It is susceptible to dead-arm disease. For those growers who market Concords as table grapes it is suggested that Van Buren and Fredonia be used for early marketing, and Sheridan and Steuben for marketing after Concord.

Catawba is the standard red grape of the American type. In New York State it assumes commercial importance in the Finger Lakes section. Except in the sites with long growing seasons, Catawba may be a failure in most years because the fruit fails to ripen satisfactorily. The vines are vigorous, hardy, and productive, but the foliage and fruit are susceptible to fungus diseases. The wine industry is the important outlet for Catawba. It makes a high-grade, white wine that is used in champagne manufacture.

Delaware is considered to be one of the highest quality American table grapes. It is also in demand for wine. The vines are not so hardy as Concord. Delaware matures its fruits early enough to make the crop certain in those sections where grapes can be satisfactorily grown. The clusters are attractive and the fruit keeps

Table 4. Principal varieties of grapes grown in the several commercial grape districts of New York State, 1955–1956*

Area	Percentage of processed grape tonnage in:				
	Concord	Catawba	Delaware	Niagara	All Others
Chautauqua district	98	0	<1	<1	1.6
Finger Lakes district	70	10	6	3	11
Hudson Valley district	97	1	1	1	
Niagara County district	80			20	

**Survey of wineries and grape processing plants New York State—1956* W. I. Blair and O. E. Grenier (Mimeographed report) N. Y. Crop Reporting Service, March, 1957.

well as compared to other varieties. The skin of the berries is tender and subject to cracking.

This variety requires a fertile, well-drained soil for good vine growth. The berries are smaller than in most other varieties, but the cluster is compact. Under good management, Delaware yields may approach those of Concord.

Niagara is the leading white grape of the American type. It can be grown in any of the grape districts of New York, although it is not so cold-hardy as Concord. It is useful for the fresh market and for wine. Niagara is moderately susceptible to the major grape diseases.

Commercial Varieties of Limited Acreage

Elvira is a white wine grape with *V. riparia* parentage. It is productive, hardy, and resistant to diseases. It ripens with Concord. The thin skin and compact clusters may cause the berries to crack.

Fredonia is a black grape that ripens about two weeks before Concord. The berries are large and the clusters are variable in size. With the recommended pruning and training it may exceed Concord in vigor and production. The fruit is highly susceptible to downy mildew.

Ives is a black, labrusca type grape used for making red wine. On the best sites it is vigorous and productive; elsewhere it may be weak-growing and unproductive.

Missouri Riesling is another white wine grape similar in origin and appearance to Elvira. It is vigorous, productive, hardy and resistant to diseases. It matures after Elvira and Concord, but before Catawba.

Dutchess is a green grape with the highest dessert and wine quality. It ripens between Concord and Catawba and appears to have a large proportion of *V. vinifera*, the European grape, in its makeup. The vine is susceptible to diseases, and is often injured by low winter temperatures.

Clinton is a red wine grape with small clusters and berries that resembles closely the wild *V. riparia*, the river-bank or frost grape. The vine grows very strongly and is also used as a rootstock.

Isabella is a black, labrusca type. One of our oldest commercial grapes in the Northeast, it has been largely supplanted by Concord which is earlier, more winter hardy, and more productive.

French Hybrid Grapes are varieties introduced by French grape breeders who produced them by crossing the European varieties with certain wild American species. These grapes carry the names of the originators and a number to distinguish them. Many hundreds have been introduced by such men as Seibel, Seyve-Villard, Baco, Burdin, Landot, Ravat and others.

They are mostly suitable for wine or juice. They lack dessert quality, although some of them do have table quality. For this reason, plantings should be made only on recommendation of the processor who will purchase the crop.

Some of the varieties that have been found to mature satisfactorily in New York and that may be of some interest for white wines are: Seibel 1000, Seibel 5279, Seibel 10868, Seibel 13047, Seyve Villard 5–276 and Ravat 6. For red wine these may be of interest: Baco No. 1, Foche, Seibel 10878 and Seibel 13053.

Varieties of Vitis vinifera or the European grape make up the commercial grape acreage of California. Since early colonial days attempts have been made to establish commercial plantings of some of these varieties in the eastern states, but with little success.

In recent years, certain eastern wineries have made experimental plantings of some of the earliest ripening, most hardy and disease resistant of these grapes. With the use of rootstocks resistant to phylloxera and other soil pests and with good disease control such varieties as the Johannisberger Riesling, Pinot blanc and others may succeed in the more favorable locations.

Varieties for the Home Vineyard and the Roadside Market

For the home vineyard and the roadside market, a collection of varieties that mature over a long season may be grown. Detailed information may be found in Cornell Extension Bulletin 733. The grower interested in trying the newest introductions should supplement this list with the catalog of the New York State Fruit Testing Association, Geneva, New York.

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